



NUCLEAR ENERGY INSTITUTE

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January 9, 2008

Dr. Jane Summerson
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U.S. Department of Energy
Office of Civilian Radioactive Waste Management
1551 Hillshire Drive
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Subject: Nuclear Energy Institute Comments on the Draft Supplemental Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca, Mountain, Nye County, Nevada

Dear Dr. Summerson:

The Nuclear Energy Institute (NEI)¹ on behalf of the nuclear energy industry, is pleased to submit these comments to the Department of Energy (DOE) on the Draft Supplemental Environmental Impact Statement (DSEIS) - *Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca, Mountain, Nye County Nevada*, (72 Fed. Reg. 58,071, October 12, 2007).

1 [It is industry's position that the United States should pursue an integrated strategy² to manage spent or used nuclear fuel – involving centralized interim storage, research, development and demonstration of advanced recycling technologies to close the nuclear fuel cycle, and disposal in a geologic repository. The DSEIS supports that goal by providing an important update to the scientific and technical bases for the licensing and development of a geologic repository at Yucca Mountain. It constitutes the most recent and comprehensive summary of the impressive body of science and engineering work that DOE has completed in preparation for the upcoming submittal of an

¹ NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, nuclear material licensees, and other organizations and individuals involved in the nuclear energy industry.

² Attached as Enclosure 1 to this letter is an industry policy statement further explaining the integrated strategy to used fuel management

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application to the Nuclear Regulatory Commission (NRC) for licenses to construct and operate the repository.

DOE has adopted a number of substantial design improvements along with the latest analytical techniques in re-evaluating the proposed action. This evaluation strengthens and reaffirms the results of DOE's 2002 Final Environmental Impact Statement (FEIS) which found impacts to be so small as to have essentially no adverse impact on public health and safety and the environment. In fact, as documented in Enclosure 2 to this letter, even these low impacts are an overestimate, and real impacts should be even lower.

Notably, DOE's recent introduction of multi-purpose Transportation, Aging, and Disposal (TAD) canisters results in considerable simplification of the repository surface facilities to further benefit worker and public health and safety. Industry has actively participated in the development of this concept. In implementing this simplification, DOE has also taken the pragmatic step of recognizing that up to 25 percent of the used nuclear fuel will arrive in non-TAD containers, such as the dual-purpose containers (DPCs) currently in use at reactor sites. Accommodating DPCs at Yucca Mountain is important because it would be inappropriate for DOE to rely on any expectation that reactor operators would incur the cost and radiation exposure of unloading DPCs. DOE should continue to work diligently to both provide for acceptance of existing DPCs at the repository and facilitate the deployment of TADs in as expeditious a manner as possible in order to maximize their use in the future.

Also noteworthy are the substantial improvements that DOE has applied to the evaluation of long-term repository environmental impacts. DOE's latest analysis shows long term radiation levels associated with the repository to be so low that an individual spending an entire year in the vicinity of Yucca Mountain – at any point in the next million years – will receive no more additional radiation than a person today receives in a typical cross country plane trip.

In offering this supplement, DOE has continued to follow the requirements of the National Environmental Policy Act (NEPA) and Nuclear Waste Policy Act (NWPA). The improvements described in the DSEIS result in impacts that are largely bounded by those evaluated in the FEIS. Accordingly, DOE could have chosen to stand on the 2002 FEIS with very little supplementation. However, the Department should be commended for taking the extra step of providing a thorough re-evaluation. In doing so, the Department has provided a strong basis upon which NRC may build to satisfy its NEPA responsibilities associated with review of the Yucca Mountain license application.

It should be also noted that, nothing related to this supplement alters the Department's original decision not to consider alternatives to the Yucca Mountain site in the FEIS. This decision remains completely consistent with the roadmap for completion of the NEPA process provided by Congress in

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the NWP. Our original position that DOE has faithfully followed this roadmap³ remains unchanged, and in fact is only reinforced, by the actions DOE is taking in providing this Supplement. }

NEI and the nuclear energy industry have extensively reviewed this DSEIS and, as a result of this review, offer specific comments in the following areas in enclosure 2 to this letter:

- I. Industry's view that the extensive design information and analysis presented in this DSEIS provide a sound foundation upon which DOE can construct its application to the NRC for licenses to build and operate the repository.
- II. Industry's recommendation that DOE retain, or even perhaps extend, the 100 to 300 year retrievability period provided for in the FEIS – to enhance the repository's ability to utilize improved disposal technologies and/or support advanced used fuel recycling and to facilitate recovery of high-level waste, if necessary, to address any problems – rather than shortening the retrievability window to the more limited 50 year post-repository operations monitoring period proposed in the DSEIS.
- III. Industry's endorsement of DOE's decision to consider, under Inventory Modules 1 and 2, the disposal of up to 130,000 metric tons of commercial used nuclear fuel and our recommendation that DOE consider and take whatever future actions necessary to facilitate further expansion of repository capacity.
- IV. Concerns regarding the extent to which DOE has overestimated several of the impacts associated with the repository as described in this DSEIS. These concerns are not intended to suggest that the use of bounding analysis is inappropriate in the context of compliance with NEPA. However we offer them as caution against the unintended consequences that could result if such overly conservative approaches are applied in the repository design and licensing.
- V. Industry's view that the sabotage analysis in the Draft Supplemental Environmental Impact Statement is extremely over-conservative and highly speculative.
- VI. Industry's view on the importance of DOE's recognition that up to 25 percent of the used fuel may be shipped to the repository in conveyances other than TADs.
- VII. A recommendation that DOE proceed with the development of infrastructure outside the NRC licensed Geologic Repository Operations Area prior to NRC authorization of repository construction, as described in this DSEIS.

³ Letter, Steven P Kraft to Wendy Dixon, Nuclear Energy Institute (NEI) comments on the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca, Mountain, Nye County, Nevada, dated February 25, 2000

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VIII. Additional information on industry capabilities that DOE should consider regarding expectations for the relative number of truck vs. rail shipments in this DSEIS.

IX. Specific detailed technical comments.

Industry offers no comments on the No Action Alternative analysis in this DSEIS. While it is appropriate for DOE to apply updated radiation dosimetry and latent cancer fatality conversion factors to the NAA for consistency with the evaluation of the proposed action, nothing about this update alters our prior conclusion⁴ that DOE has presented two "no action alternative" scenarios that comprehensively bound the range of no action possibilities. There remains no need for DOE to attempt to define and evaluate specific "more likely" scenarios within these bounds. Such additional analysis would not provide readers with any better means to make a comparison than that already given.

NEI looks forward to maintaining an active ongoing dialogue with DOE on items of mutual interest with respect to the proposed Yucca Mountain repository as the project moves into the licensing phase of its development. We would be pleased to address any questions the agency may have on our comments.

Sincerely,



Rodney McCullum

Enclosures

c: The Honorable Edward F. Sproat, Director, DOE, OCRWM
The Honorable James L. Connaughton, Council on Environmental Quality
Mr. Michael F. Weber, Director, U.S. Nuclear Regulatory Commission, NMSS
Ms. Elizabeth Cotsworth, Director, Office of Radiation and Indoor Air, Environmental Protection Agency

⁴ Ibid.

ENCLOSURE 1

Nuclear Energy Industry Supports Integrated Used Fuel Management Strategy

The industry supports a three-pronged integrated used fuel management strategy:

- 1) interim storage until recycling or permanent disposal—or both—are available;**
- 2) research, development and demonstration to close the nuclear fuel cycle;**
- and 3) developing a permanent disposal facility.**

Interim storage sites at volunteer locations will enable the Department of Energy to move used fuel from both decommissioned and operating plants before recycling facilities or the repository begin operating.

- Intermediate steps also are needed as the government pursues permanent disposal. These reflect the emphasis on closing the fuel cycle and sustainable development of advanced nuclear fuel cycle technologies. These technologies can reduce the volume, heat and toxicity of byproducts placed in the repository and reclaim a significant amount of energy that remains in used fuel.

The industry's long-term objective is the isolation of byproducts and/or used fuel in a specially designed underground repository. This position is consistent with the international scientific consensus that deep geologic disposal is the most effective means of protecting public health and the environment. Congress has designated Yucca Mountain as the country's repository site, based on sound science supported by decades of rigorous investigation. The repository must be licensed by the Nuclear Regulatory Commission prior to construction and operation.

An integrated used fuel management program includes key deliverables phased in the short-, medium- and long-terms.

- *Short-term goals* include:
 - Continued waste confidence and a standard contract covering used fuel management for new plants.
 - Starting the Yucca Mountain licensing process, including DOE's submittal of its application to the Nuclear Regulatory Commission.
 - Developing a well-defined research and development program for fuel recycling technologies.
 - Identifying and developing volunteer sites for advanced fuel cycle facilities, including interim storage of used reactor fuel.

Medium-term goals include:

- Moving used fuel to interim storage sites by the federal government, ideally at advanced fuel cycle development sites.
- Continuing research, development and demonstration of advanced fuel recycling and fuel fabrication technologies to make them more cost-effective and efficient, and to maximize uranium recycling.
- Yucca Mountain repository licensing.

- *Long-term goals* include:

- Operating advanced fuel recycling and fuel fabrication facilities.
- Operating the Yucca Mountain repository.

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ENCLOSURE 2

**NUCLEAR ENERGY INSTITUTE (NEI)
COMMENTS ON
THE U.S. DEPARTMENT OF ENERGY'S
DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT**

"Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada"

- I. The extensive design information and analysis presented in this DSEIS provide a sound foundation upon which DOE can construct its application to the NRC for licenses to build and operate the repository.

3 DOE's Draft Supplemental Environmental Impact Statement (DSEIS) provides a comprehensive evaluation of the short- and long-term environmental and human health impacts of the proposed major federal action – the construction, operation, monitoring, and closure of a deep geological repository for spent nuclear fuel (also referred to as "used nuclear fuel") and high level radioactive waste at Yucca Mountain, Nevada. The depth and breadth of the document is truly impressive. The extensive body of reference material, calculations, analysis, and other documentation supporting the Total System Performance Assessment (TSPA) provides a thorough accounting of the scientific and technical basis of the DSEIS. DOE is to be commended for taking the extra step of providing this supporting information (in the form of 6 gigabytes of reference material, 500 megabytes of calculations, and 300 gigabytes of electronic file documentation) to stakeholders to support their review of the DSEIS. The fact that DOE found short- and long-term impacts of repository construction and operation to be extremely small provides a compelling argument for moving forward with the licensing phase for Yucca Mountain.

The pre-closure environmental impacts described in the DSEIS thoroughly consider repository construction, operation, monitoring and closure and were shown to be small. For example, DOE found that air quality will be fully protected and impacts are well within regulatory limits; and that groundwater and surface water impacts, biological resources and soil impacts would be small. In addition, cultural resource impacts and socioeconomic impacts were also determined to be minimal. Most significantly, DOE's highly conservative evaluation of public and worker radiological impacts shows that health and safety will be protected. This evaluation makes it clear that the Yucca Mountain project has benefited substantially from improvements made since the 2002 Final Environmental Impact Statement (FEIS), most significantly the adoption of the Transportation, Aging, and Disposal (TAD) canister system.

It is particularly notable that, as discussed in Section 4.1.7.2.6, page 4-65, about 99.9 percent of radiation related pre-closure health impacts would be from exposure to naturally occurring radon and its decay products. A point of comparison should be made to other ongoing activities that cause radon exposure such as mining operations throughout the State of Nevada and how much radon radiation dose is caused by such ongoing operations for the same period as repository construction. Such a comparison would provide valuable information to demonstrate the low and routine nature of these impacts.

The post-closure impacts described in the DSEIS were also shown to be small, with mean radiation doses over the first 10,000 years projected to be less than 0.24 mil-

lirems per year to "reasonably maximally exposed" residents who may be located 18 kilometers from the repository and radiation doses over the entire 1 million year period evaluated less than 2.3 millirem per year at the same point. These peak doses are far below regulatory limits proposed by the Environmental Protection Agency (EPA) and Nuclear Regulatory Commission (NRC) and represent less than a 1 percent increase in the annual radiation exposure to any person living in the vicinity of Yucca Mountain.

In determining these results, DOE is to be commended for incorporating a number of analytical improvements in its post-closure TSPA – four examples of which are listed below.

Section 5.1.1. DOE should be commended for incorporating analytical improvements identified in the proposed revision to EPA's Yucca Mountain radiation protection standard into this DSEIS. Specifically, the improved approach to modeling long-term climate change and the use of revised International Commission on Radiation Protection weighting factors for calculation of individual doses provide a much more credible, transparent and reasonable evaluation of the potential radiological impacts of the repository beyond 10,000 years. In the latter case, the application of more up-to-date biosphere dose conversion factors for neptunium (Np) is particularly significant and is more consistent with independent performance assessments such as that performed by the Electric Power Research Institute (EPRI).

- Table 5-1, pages 5-7 and 8. DOE should be commended for updating its performance assessment models in several areas to provide more realistic results. For example, the in-drift chemistry modeling that constrains in situ water chemistry and the inclusion of thermal dependency in general corrosion rates are more realistic than previous model inputs.

Section 5.1.2, page 5-10 regarding chemical toxicity of repository releases is improved over the FEIS analysis by using more reasonable inputs regarding the oxidation state chemistry and aqueous speciation of dissolved chromium. DOE is commended for removing unreasonable conservatism from previous analyses.

Section F.4.1.2.1 describes the role that radionuclide solubility plays in the contribution that each radionuclide makes to long-term post-closure radiological impacts. Our review of reference materials for DOE's performance assessment indicates that in the TSPA prepared for this DSEIS, DOE has revised its Np solubility parameters to provide a more realistic assessment of Np mobility in the subsurface. DOE is to be commended for doing this as it eliminates excessive conservatism in the analysis and establishes improved consistency between DOE's performance assessment and independent performance assessments such as that conducted by the Electric Power Research Institute (EPRI).

While these improvements provide for a much more realistic assessment of the likely future performance of Yucca Mountain, we still believe that DOE's analysis is highly conservative. In Comment IV we have identified a number of conservatisms that DOE should further address as it proceeds with the design and licensing of the repository. }

- II. **Industry recommendation that DOE retain, or even perhaps extend, the 100 to 300 year retrievability period provided for in the FEIS – to enhance the repository's ability to utilize improved disposal technologies and/or support advanced used fuel recycling and to facilitate recovery of high-level waste, if necessary, to address any problems – rather than shortening the retrievability window to the more limited 50 year post-repository operations monitoring period proposed in the DSEIS**

Given that repository emplacement and disposal technologies will almost certainly improve over time and that used nuclear fuel has significant resource value as a source of additional energy production – and, moreover, the increasing interest amongst a number of stakeholder groups in recovering that value through advanced used fuel recycling technologies that will also provide for advanced and more manageable high-level waste forms – DOE should be seeking to provide as much opportunity as possible for used fuel to be retrieved at some point in the future. The significant number of potential host communities and corporate entities that have expressed interest in becoming involved in DOE's Global Nuclear Energy Partnership (GNEP), a program that calls for significant research and development of recycling technologies, is evidence of this interest. Through GNEP and other programs, recycling technologies will continually evolve and advance over time, resulting in ever greater portions of the inventory of fissionable material in the used fuel becoming economically recoverable.

Accordingly, DOE should, in the SEIS, be considering as long a period of retrievability as is practicable. Industry is highly disappointed that DOE has chosen, as indicated on page S-10 of the DSEIS, to shorten the retrievability period to 50 years following the completion of 50 years of repository operations from the previously envisioned 100 to 300 year retrievability period (as indicated on page S-21 of the FEIS). We therefore recommend that DOE revise the DSEIS to at, at a minimum, restore consideration of the 100 to 300 year window and perhaps, consider evaluating longer periods as appropriate. Longer retrievability periods will also enhance public confidence because this would provide a greater opportunity to take advantage of repository monitoring to detect and correct any problems that might be identified in the future.

An enhanced repository, one in which the concept of extended monitoring and retrievability is a fundamental part of the design and licensing basis, is not only necessary to support the ongoing progress towards the deployment of advanced recycling technologies, but also has a strong basis in existing law and regulation. This is described in the following paragraphs.

Section 2 of the NWPA defines a "repository" as "any system licensed by the Commission that is intended to be used for, or may be used for, the *permanent deep geologic disposal* of high-level radioactive waste and spent nuclear fuel, whether or not such system is designed to permit the recovery, for a limited period during initial operation, of any materials placed in such system" (Emphasis added.) The same section also defines "disposal" as "the emplacement in a repository of high-level radioactive waste, spent nuclear fuel, or other highly radioactive material with *no foreseeable intent of recovery*, whether or not such emplacement permits the recovery of such waste." (Emphasis added.)

However, while the law provides for "permanent ... disposal" of spent fuel "with no foreseeable intent of recovery," section 122 of the NWPA specifically requires that

"any repository ... shall be designed and constructed *to permit the retrieval of any spent nuclear fuel placed in such repository, during an appropriate period of operation of the facility*, for any reason pertaining to the public health and safety, or the environment, or for the purpose of permitting the recovery of the economically valuable contents of such spent fuel." (Emphasis added.) Section 122 of the Act further provides that, "The Secretary [of Energy] shall specify *the appropriate period of retrievability* with respect to any repository at the time of design of such repository, and such aspect of such repository shall be subject to approval or disapproval by the Commission as part of the construction authorization process" (Emphasis added.) Thus, although the law prescribes a program for final, terminal disposal, it also requires that retrievability be maintained, as appropriate.

Given the significant investment that the federal government is now making in advanced nuclear fuel cycle development and is likely to continue to make in the future, the meaning of the statutory term "appropriate" should be interpreted in the context of these technology development programs. And in this context, in which advanced technologies will continue to develop and progress over many decades if not centuries, longer, not shorter, retrievability periods are more appropriate.

Consistent with governing federal statutes, federal agency regulations require that provisions be made both for retrievability and federal monitoring, to confirm that the repository is meeting all performance criteria. Specifically, under section 63.111(e) of NRC regulations, DOE must preserve retrievability throughout the period during which radioactive material is being loaded into the repository, and thereafter until the completion of a repository performance confirmation program.

To satisfy this obligation, the regulations require a repository design "so that any and all of the emplaced waste could be retrieved on a reasonable schedule starting at any time up to 50 years after waste emplacement operations are initiated" In fact, as addressed in DOE's 2002 Final Environmental Impact Statement for the Yucca Mountain repository, the Department is contemplating repository designs that would permit retrievability up to 300 years.

With respect to monitoring, Subpart F of the Commission's repository regulations requires a "Performance Confirmation Program." To meet the requirements of this program, DOE must furnish data indicating:

- (1) whether actual underground conditions encountered and changes to those conditions during construction and repository loading are within the limits assumed during licensing; and
- (2) whether natural and man-made engineered repository systems and components, that are designed or assumed to operate as barriers after permanent closure, are functioning as intended and anticipated.

The performance confirmation program must be implemented until final repository closure. DOE must provide baseline information and analysis addressing those parameters and natural processes related to the geologic setting that may be changed by repository construction and operation; and monitor and analyze changes from the baseline that could affect repository performance.

Pursuant to section 63.32 of the NRC's regulations, retrievability and performance confirmation concepts can be incorporated into the Construction Authorization (CA) as specific license conditions. In fact, the regulations specifically require DOE reports regarding "[t]he results of research and development programs being conducted to resolve safety questions."

Further, in pursuit of the concept for enhanced monitoring and reversibility, DOE should, itself, propose conditions prescribing additional requirements. For example, the Department could specifically request a license condition directing that retrievability be maintained over a period of 300 years or more. It could also seek a CA condition detailing individual elements of an extensive performance confirmation program and appropriate remediation, if problems occur, up to and including retrieval.

In addition to retrievability and monitoring, DOE could seek a condition imposing a requirement for the periodic amendment of the license, perhaps every 50 or so years. Periodic amendment - and associated licensing proceedings - would be to evaluate the results of DOE's ongoing performance confirmation program, and provide for the addition or removal of license conditions, as appropriate. Recurrent amendment would be analogous to the recertification process applied by the Environmental Protection Agency (EPA) at DOE's Waste Isolation Pilot Plant (WIPP), in New Mexico, the nation's first underground geologic disposal facility for radioactive waste¹. Routine amendment of the Yucca Mountain license - according to specific conditions incorporated in the license, itself - would ensure continued monitoring, public involvement, and corrective action, if appropriate, at the repository.

A stronger focus on extended monitoring and retrievability of materials placed in the Yucca Mountain repository can be accommodated through the enhanced repository concept discussed in these comments. Advantages of the concept include increased public confidence; the ability to utilize innovative disposal technologies and techniques, as they develop in the future; and facilitated licensing. This concept can be accomplished wholly within the existing federal statutory and regulatory framework. }

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III. **Industry welcomes DOE's decision to evaluate the environmental impacts of an increased used nuclear fuel inventory of up to 130,000 metric tons in Inventory Modules 1 and 2 as a step in the right direction. Industry believes that additional expansion in repository capacity, beyond this amount, is possible and that DOE should, in the future, take whatever actions necessary to facilitate such additional expansion.**

Industry welcomes DOE's decision, as indicated in Sections 8.3.1 and 8.3.2 to increase the amount of commercial used nuclear fuel evaluated in Inventory Modules 1 and 2 from 105,000 in the FEIS to 130,000 in the DSEIS. Sections 8.3.1 and 8.3.2, page 8-25 discuss Inventory Modules 1 and 2 under which DOE analyzes the currently projected amount of used nuclear fuel to be produced by the current generation of nuclear power reactors, if that used fuel were disposed at a Yucca Mountain Repository. DOE is commended for updating its analysis based on increased used nuclear fuel projections since the Repository FEIS was prepared. Such analysis should be helpful as DOE considers its upcoming recommendation regarding the need for a second repository. DOE should not stop with the mere *consideration* of repository expansion, but should take whatever actions are necessary to further develop the technical basis for such expansion and secure the legal authority for implementation.

The increased inventory would provide for the disposal in Yucca Mountain of all existing commercial used nuclear fuel as well as additional amounts that would arise

¹Under the recertification process, DOE must submit a recertification application to EPA every five years documenting WIPP's continued compliance with regulatory requirements. EPA then reviews the recertification application to determine whether the facility remains in compliance, and the public is provided an opportunity to inspect and comment on the application.

for the next 37 years for the existing fleet of reactors. Given the current pattern of power plant license extensions, and the possibility of a second round of extensions, it is certainly prudent to expect that this additional disposal capacity for this inventory will be needed.

In addition to extending the life of current reactors, industry expects a significant number of new reactors to be built in the US in coming decades. Accordingly, DOE should also continue to evaluate additional increases in Yucca Mountain disposal inventory to accommodate used nuclear fuel disposal from new reactors. Industry believes that there is a sound scientific and technical basis for such additional increases. A recent study by the Electric Power Research Institute (EPRI)² found that the actual physical capacity of Yucca Mountain could be as high as 570,000 metric tons of commercial used nuclear fuel. And, if advanced reprocessing technologies were applied to reduce the volume, heat load, and radioactivity of the waste, this number could be significantly higher. It is, therefore, quite possible that Yucca Mountain might be the only repository the US would ever need. DOE should explore this potential, especially as it evaluates the need for a second repository.

Should DOE be successful in obtaining authority to increase repository capacity, one aspect of the repository design that will need to be reconsidered is the size of the aging pads described in Section 2.1.2.1.5. While industry data on the heat load associated with the existing and projected inventory of used nuclear fuel indicates that the 21,000 MTU of surface storage evaluated in the DSEIS is adequate to support the proposed action, our information also indicates that accommodating the additional inventory of Modules 1 and 2 would require additional aging capacity.

Finally, regarding the specific analysis in the DSEIS, Section 8.3.1, page 8-25 discussing a scaling approach to Inventory Modules 1 and 2, DOE is commended for using a common sense approach for scaling the 70,000 MTHM repository impact estimates to estimates for Inventory Modules 1 and 2. Such a straightforward and reasonable approach is easily explained and understood.]

7 IV. **Even though the Draft Environmental Impact Statement finds the impacts of the proposed action to be small, it has significantly overestimated these impacts in several respects.**

In conducting the performance assessment and other analyses that led to the determination of impacts presented in this DSEIS, DOE has built in a number of conservative assumptions intended to establish a certain margin of confidence in the results. While the use of conservative analyses does provide additional confidence in safety, conservatism should not be employed to the point where it results in increased complexities in repository design that could subject workers constructing the repository to additional risks or unnecessarily delay the repository development process. We understand the use of bounding analysis in the context of an EIS that must comply with both the National Environmental Policy Act (NEPA) and DOE's internal NEPA requirements and are not contending that the DSEIS is in any way deficient because of these conservatisms. However, we make these comments to caution DOE against the unintended consequences that could result if such overly conservative approaches continue to be applied in the repository development process.

² EPRI Program on Technology Innovation Report: *Room at the Mountain, analysis of the Maximum Disposal Capacity for Commercial Spent Nuclear Fuel in a Yucca Mountain Repository*, Technical Report # 1015046, June 2007

In our review of the DSEIS, we found the following examples of areas where DOE's use of conservatism could be reduced or, at least, better explained.

Section 2.4.2, page 2-79, states DOE has continued analyses to "... better define or reduce uncertainties..." Understanding the uncertainties associated with the performance assessment is an essential undertaking. However, reducing those uncertainties is not necessarily a worthwhile pursuit if the current level of uncertainty is adequate for decision making and provides for a reasonable expectation of regulatory compliance. In addition, while the incorporation of bounding assumptions may appear to reduce uncertainties, the real effect is to overestimate the actual risk. For example, incorporating the assumption that all waste packages are destroyed during an igneous intrusion is overly conservative, but the performance assessment plots will appear to have less uncertainty because no uncertainty range is considered for this assumption. DOE's goal should be to understand and explain uncertainties, not necessarily to reduce them.

Section 4, page 4-1, states, "The methods DOE used in the analyses to predict the potential impacts in this section are conservative. This means that the predicted results are likely higher than the actual values that would be measured or observed." It goes on to say that the analysis does not take credit for "... applying DOE radiation protection program objectives such as As Low As Reasonably Achievable (ALARA) into worker radiation exposure analyses." Taking absolutely no credit for radiation protection programs is overly conservative. DOE should refine its approach to consider at least some level of radiation protection while still being conservative regarding its effectiveness.

Overly conservative estimates can lead to poor decision making regarding project design, operations, and development activities. It also provides erroneous information to the public and can lead to the perception of much higher than actual risk. Where DOE presents known overly conservative estimates, it should accompany the unrealistically conservative estimates with estimates of a more reasonable scenario. In this way risks can be better understood by the public and decision makers regarding the future of the Yucca Mountain Project. There can be reasons to provide bounding calculations, but doing so, without providing an adequate context for understanding the risk, through the use of more realistic scenarios and estimates could result in public confusion and misunderstanding. In any case known conservative estimates should never be termed as predictions as is done in this section.

In the case of seismic scenarios, use of overly conservative estimates will lead to over-design of the surface facilities. As mentioned below in our comment on Appendix E2.1.2.2 the need for additional materials such as concrete and concomitant increases in labor needs will potentially increase risk to construction workers due to routine accidents and represents ineffective use of resources.

- Section 4.1.7.2, page 4-59, has a text box that describes conservative assumptions used in the DSEIS radiological impact analysis. For instance, 1) it assumes workers would work 50 years in the same job handling used nuclear fuel, 2) it assumes all fuel will be at the radioactive design basis limit, 3) it assumes no radiation protection administrative limits would be applied, and 4) it assumes the most exposed member of the public would stand at the site boundary for 70 consecutive years. These assumptions are grossly conservative, as DOE apparently acknowledges, and, at a minimum, analytical results should be presented using more reasonable assumptions.

- Section 4.1.7.2.6, page 4-65, Table 4-24 (and Appendix D, Section D.4.3, page D-21, Table D-11) Section 4.1.7.2.6, Table 4-24, page 4-65 (and Appendix D, Section D.4.3, page D-21, Table D-11) summarizes the "collective dose" to the population within an 80-mile radius of the repository, with a dose of 13,000 person-rem summed for the entire population over the entire project. The table notes that the population is assumed to be 117,000 persons and the total project duration is 104 years. If one examines the collective dose as an average dose to a member of the population for one year, an individual would receive, on average, 1.1 millirem per year (less than 1% of natural background radiation). The National Council on Radiation Protection and Measurement (NCRP) cautions against the use of collective dose, noting that there are questions regarding the "applicability of the collective dose concept to large populations with very small individual doses and to populations that will exist several generations hence."³ Table 4-24 identifies the Maximally Exposed Individual (MEI) receiving a calculated maximum annual dose of 1.3 to 6.8 millirem per year, with a Latent Cancer Fatality (LCF) probability of 0.0003 – which is essentially zero. Since it is unlikely, at this dose level that the MEI would develop cancer, let alone die, from the cumulative calculated maximum dose, one should reason that no other member of the population within the 80 mile radius would develop cancer from a dose that is less than the MEI dose. Thus, while one can calculate a total of 8 latent cancer fatalities based on the collective population dose of 13,000 person-rem, the expected number of additional LCF would also be essentially zero. This same statement would apply to the calculation of population dose-risk in the transportation risk assessment under normal and accident conditions discussed below. If DOE plans to continue to utilize collective dose in the DSEIS, DOE should include a discussion that puts the collective dose into perspective. Results from more reasonable scenarios and assumptions should also be presented in order to provide the public with more realistic consequences.
- Section 4.1.8.4, page 4-67, discusses another intentionally conservative assumption regarding consequence mitigation. It assumes no interdiction after a severe accident that results in the oxidation and release of fuel pellet material. Such a high degree of conservatism may be adequate for regulatory purposes, but far overstate consequences in environmental impact assessments. A more reasonable scenario should also be analyzed and results presented.

Section 4.1.8.2, page 4-69, states, "The analysis assumed neither DOE nor other government agencies would implement mitigation measures, such as evacuation, to limit long-term radiation doses." This is an unreasonable assumption for accident analyses. At a minimum, DOE should reevaluate the accident scenarios with the highest consequences with reasonable assumptions regarding evacuation and other factors and state those results along side the grossly conservative (bounding) analysis results.
- Table 5-1, page 5-7, and Section F.2.2, pages F-8 and F-9, and Table F-1: We note that DOE has completely revised its infiltration model for the SEIS. The 90th-percentile values for infiltration rates for present day and monsoon climates appear to be high and therefore represent another case of overly conservative estimation for post-closure performance. EPRI results⁴ (1998, 2002a) indicate

³ NCRP, Principles and Application of Collective Dose in Radiation Protection, NCRP Report No. 121, November 30, 2005.

⁴ EPRI. (1998). Alternative Approaches to Assessing the Performance and Suitability of Yucca Mountain for Spent Fuel Disposal, EPRI TR-108732, Electric Power Research Institute, Palo Alto, CA, and EPRI. (2002). Evaluation of the Proposed

lower numbers for the extreme ranges of net infiltration rates and are comparable to the results from the previous Yucca Mountain infiltration model developed by the USGS.

- Table 5-1, page 5-7, and Section F.2.2, pages F-8 and F-9, and Table F-1: It is worth noting that because of overly conservative assumptions regarding early waste package failure, the effect of infiltration rates on repository performance for the first 10,000 year period is greatly amplified over what industry has determined to be the case. In particular, the aggregation of conservative assumptions that result in early waste package failure, including discounting of fuel cladding (Table 5-1, page 5-7), accelerated rock fall and drift collapse due to discounting of structural drift support (Section 5.2.2, page 5-12), and overestimation of manufacturing defects in waste packages (Appendix F, page F-15), directly results in greater sensitivity of repository performance (risk/dose) to infiltration rates. Independent assessments by EPRI indicate that early failure of waste packages is a much lesser concern over the first 10,000 year period. Therefore, increased infiltration rates during this timeframe would not be strong drivers of risk or dose.

Table 5-1, page 5-8 and section 5.1.1.3, page 5-9. The assumption that all waste packages are destroyed in the event of an igneous intrusion is overly conservative. There is no explanation of why the DOE has taken such an unrealistic approach. In light of improvements to other areas of the modeling, this is a giant step backwards. EPRI analysis suggests that DOE's SEIS significantly overestimates the dose impacts resulting from igneous intrusion. EPRI has determined that magma intrusion would affect no more than 10% of the drifts. Furthermore, the magma would not completely fill the drifts into which it intruded because DOE has overestimated the temperature and underestimated the viscosity of the magma entering the drifts. Finally, DOE's assumption that the magma entombing the waste packages would not prevent groundwater ingress is also conservative. Hence, EPRI's analysis suggests that DOE's igneous intrusion scenario dose results have been overestimated by at least one order of magnitude.⁵

- Section 5.5, page 5-25, mentions that the Igneous Scenario Class includes a Volcanic Eruption Modeling Case. EPRI has determined that DOE has overestimated the dose impacts due to the volcanic eruption case by on the order of 8 orders of magnitude.⁶
- Section 5.2.2, page 5-12. DOE notes that the repository drift tunnels have been redesigned such that the tunnels now have significant stainless steel ground support. However, it appears that DOE has potentially very conservatively assumed that the ground support effectively disappears the instant the repository is closed. It is likely that a significant portion of the ground support system will continue to function well into the peak thermal period. If so, the ground support could prevent the significant amount of rockfall during this period that DOE pro-

High-Level Radioactive Waste Repository at Yucca Mountain Using Total System Performance Assessment: Phase 6. Report number 1003031. Electric Power Research Institute, Palo Alto, CA.

⁵ Potential Igneous Processes Relevant to the Yucca Mountain Repository: Intrusive-Release Scenario. EPRI, Palo Alto, CA: 2005. {1011165}.

⁶ Potential Igneous Processes Relevant to the Yucca Mountain Repository: Extrusive-Release Scenario - Analysis and Implications, EPRI, Palo Alto, CA, : 2004 {1008169}.

jects. Significant reduction in the amount of rockfall during the thermal period will likely extend the waste package lifetimes, perhaps considerably.

- Table 5-4 and Section 5.5.1, page 5-26 state that the mean annual 10,000 year dose to the RMEI could be as high as 0.24 millirem. Section F.4.1.1, page F-33 says the nominal scenario class contributes zero mean annual dose; section F.4.2.1.1 says the igneous intrusion modeling case contributes about 0.06 millirem to the total; section F.4.2.2.1 says the seismic ground motion modeling case contributes about 0.2 millirem to the total. However, the igneous intrusion case is overly conservative because it assumes 100 percent of the repository waste packages are destroyed if an igneous intrusive event occurs. The seismic ground motion modeling case is also grossly conservative because it assumes, per section F.4.2.2.1, that "... each epistemic realization has essentially the same set of future conditions. That is, each epistemic realization has the same number of events, the same event times, and the same event magnitudes. As a result, all epistemic realizations and their spikes reinforce each other in the calculation of the mean and median annual doses..." Modeling discrete low probability seismic events at precise points in time in a probabilistic model is overly conservative. Practically the entire estimated 10,000 year mean annual dose is, therefore, predicated on the two overly conservative assumptions. The use of such unrealistic and overly conservative assumptions should be corrected. At a minimum, the grossly conservative assumptions should be recognized as driving nearly 100 percent of the estimated 10,000 year mean annual dose. In addition, tabular data showing the contributing factors to the 10,000 year total dose should be provided in the main body of the DSEIS.
- Table 5-4, page 5-26 and section 5.5.2, page 5-29 state that the mean annual 1 million year dose to the RMEI could be as high as 2.3 millirem. Section F.4.1.1, page F-33 says the nominal scenario class contributes 0.5 millirem to this total; section F.4.1.2.2 says the waste package early failure modeling case contributes about 0.2 millirem to the total; section F.4.2.1.1 says the igneous intrusion modeling case contributes about 1.3 millirem to the total; section F.4.2.2.1 says the seismic ground motion modeling case contributes about 1.5 millirem to the total. However, the igneous intrusion case is overly conservative because it assumes 100 percent of the repository waste packages are destroyed if an igneous intrusive event occurs. The seismic ground motion modeling case is also grossly conservative because it assumes, per section F.4.2.2.1, that "... each epistemic realization has essentially the same set of future conditions. That is, each epistemic realization has the same number of events, the same event times, and the same event magnitudes. As a result, all epistemic realizations and their spikes reinforce each other in the calculation of the mean and median annual doses..." Modeling discrete low probability seismic events at precise points in time in a probabilistic model is overly conservative. Most of the 1 million year mean annual dose is, therefore, predicated on the two overly conservative assumptions. The grossly conservative assumptions should be corrected. At a minimum, the overly conservative assumptions should be recognized as driving most of the 1 million year mean annual dose. In addition, tabular data showing the contributing factors to the 1 million year total dose should be provided in the main body of the SEIS along with an explanation of why the total is less than the sum from all the scenario classes.
- Figure 5-6, page 5-29. The lack of smoothness in the mean projected annual dose curve for the post-10,000 yr. period suggests for example that events are correlated in time across scenario classes and simulations. Such correlations,

such as had been done for climate change in the FEIS, are inappropriate for a risk-based calculation.

Figure 5-7, page 5-30. We note that the DSEIS projections for the post-10,000 yr. period indicate that Ra-226 will contribute the most of any nuclide to the mean annual individual dose (40% at RMEI location) is a marked departure from previous results, including the original FEIS, and a rather unexpected result. This result warrants further explanation or clarification, especially given the relatively large partitioning coefficient and modest half-life for Ra-226. Furthermore, Table 5-5 indicates a 95th-percentile value for Ra-226 that is 2 orders of magnitude smaller than the mean. While the discussion on page 5-27 does address this peculiar result, it would seem reasonable to expect additional elaboration on the Ra-226 modeling results.

- Table 6-1 identifies the representative PWR used fuel assembly as having a burnup of 60 GWD/MTU, an initial enrichment of 4.0 weight-percent (w/o) U-235, and a decay time of 10 years. The representative BWR used fuel assembly has a burnup of 50 GWD/MTU, an initial enrichment of 4.0 w/o U-235 and a decay time of 10 years. While the use of the higher burnups for PWR and BWR used nuclear fuel are reasonable for a bounding analysis, it is unlikely that fuel assemblies with initial enrichments of 4.0 w/o U-235 would be able to achieve these discharge burnup levels. As DOE should know from the information that it collects via DOE Form RW-859, PWR fuel assemblies with exposures reaching 60 GWD/MTU have initial enrichments that are generally above 4.8 w/o U-235. The result of DOE's assumed 4.0 w/o U-235 initial enrichment for PWR fuel is a higher source term which results in higher accident and sabotage dose risk (DIRS 161120, Section 5.5.2.). It should also be noted that the assumption that all shipments will contain used nuclear fuel with characteristics of the representative PWR and BWR fuel assemblies is another overly conservative assumption as much of the fuel will have cooling times well in excess of ten years. Over a range of possible shipping strategies evaluated by DOE's M&O contractor in 2002, more than 40% of fuel shipped is likely to have cooling times of greater than 20 years.⁷

Section 6.2.3, page 6-9, Table 6-2, states the maximally exposed individual worker loading casks at generator sites would receive 25 rem based on an assumption that this individual would receive an annual administrative limit of 500 millirem per year for a 50 year working life. Even though page 6-10 recognizes this is "unlikely," such grossly conservative assumptions should be avoided. Instead of making the unreasonable assumption that the same person would receive the maximum allowed dose for 50 consecutive years, only the maximum annual results should be presented.

Furthermore, even if an individual were to work the same fuel loading job for 50 consecutive years, which would be unprecedented, use of the maximum annual results based on the administrative dose limit of 500 millirem would still be overly conservative. Industry has achieved an outstanding safety record in the loading of over 900 dry casks. We have considerable experience in maintaining radiation exposures As Low As Reasonably Achievable (ALARA) in the loading of these casks and would continue to apply the same principles to the loading of TADs and other containers for shipment to Yucca Mountain. It should be noted that industry experience indicates that the average worker dose is less than 200

⁷ Bechtel SAIC, 2002 Design Basis Waste Input Report, TDR-COW-SE-000022 Rev 00, September 2002, MOV.20021017.0001 (BSC 2002)

millirem per year.⁸ We, therefore, do not agree with DOE's decision to assume that workers at reactor sites would receive the administrative dose limit of 500 millirem per year, every year, no matter how short or long his or her career might be.

It should also be noted that DOE makes similar assumptions in Table 6-5 for the maximally exposed transportation workers (page 6-17). As in the case of reactor site workers, we view these assumptions as overly conservative.

- Section 6.3.1, page 6-12, discusses methods for estimating transportation impacts. One of the assumptions is that the radiation levels emitted from transportation casks will be at the regulatory limit of 10 millirem per hour at a distance of 2 meters for every transportation cask. This should be recognized as conservative since not all casks will be loaded with fuel that has the characteristics that would result in the cask external dose rate being at the regulatory limit. In EPRI report, Assessment of Incident Free Transport Risk for Transport of Spent Nuclear Fuel to Yucca Mountain Using RADTRAN 5.5,⁹ EPRI noted that since more than 40% of the fuel shipped is likely to have been cooled for times greater than 20 years, cask external dose rates will be lower than the regulatory limit for the majority of packages shipped. Incident free dose is directly proportional to the cask external dose rate. Thus, if one assumes that the external dose rate is 30% lower than the regulatory limit, the calculated incident free dose will be 30% lower. It is suggested that DOE either replace this assumption with a more realistic assumption based on projected waste streams or on an estimate using statistical average radiation limits from previous shipments or include a more realistic estimate as a point of reference. As identified in EPRI 2005, there are also other conservative assumptions contained in the calculation of the radiological risk associated with incident free transportation that result in an overstatement of risk. These conservatisms should be recognized and identified to assist decision makers and the public in evaluating the results presented in the SEIS.
- Section 6.3.1, Table 6-5 (page 6-17) identifies the incident free radiological risk for maximally exposed works and members of the public. DOE assumes that the member of the public with the maximum radiation dose would be a service station attendant who refueled trucks. DOE notes that its assumption that the same person would refuel 600 trucks over 50 years and would receive a dose of 0.21 rem is an assumption that "overstates" the risk. DOE should not stop at mere recognition of this, but should replace this excessive conservatism with something more realistic assumptions in its analysis.
- Section 6.3.3.2, page 6-19 discusses impacts of severe accidents and presents a text box saying the State of Nevada has an opposing viewpoint that the consequences of severe accidents could be much greater than estimated by DOE. Many of the assumptions made by DOE in the calculation of accident risk are conservative, resulting in an overestimate of accident risk, and should be noted as such. For example, the accident analysis assumes that no shielding is provided by buildings which results in an increase in the dose to urban populations in the event of an accident; there is no interdiction or cleanup; a upper estimate of radioactive material deposition on used fuel is utilized to calculate Co-60 concentrations; and that the source term is based on the conservative reference

⁸ World Association of Nuclear Operators (WANO), 2004 Industry Performance Indicators, Collective Radiation Exposure, p. 16

⁹ EPRI, Assessment of Incident Free Transport Risk for Transport of Spent Nuclear Fuel to Yucca Mountain Using RADTRAN 5.5, # 1011821, September 2005 (EPRI 2005).

PWR assembly characteristics. In a reassessment of transportation accident risk performed by EPRI in 2006, EPRI found that overall accident risk could be reduced by 35% to 40% with the use of less conservative, more realistic assumptions.¹⁰ If the accident analysis assumes evacuation, interdiction and cleanup, accident dose risk can be reduced by 70%. In addition, neither the accident analysis nor the sabotage analysis (Section 6.3.4) take credit for the fact that DOE assumes that at least 75% of the used fuel will be shipped in TAD canisters – an additional barrier that is not accounted for in the release fractions utilized in the FEIS and DSEIS. Where inputs are unrealistically conservative, recognition of this should be highlighted. This recognition should be applied in responding to the State of Nevada viewpoint to show how DOE has applied the very conservative input assumptions to derive gross overestimates, as opposed to underestimates, of accident consequences.

- In Section 6.3.3.2, the assessment of the maximum reasonably foreseeable accident considered accidents with a probability of more than 1×10^{-7} (1 chance in 10 million) – this is an order of magnitude lower than NRC guidance regarding “credible” accident, defined as accidents with a probability of 1 chance in 1 million.¹¹ The SEIS evaluated this “reasonably foreseeable” accident as having a frequency of 8×10^{-6} per year and would involve a long-duration, high-temperature fire that would engulf a cask. This maximum reasonably foreseeable accident does not take into account recent action by the U.S. Nuclear Regulatory Commission (NRC) staff and the American Association of Railroads (AAR) to reduce the probability of rail accidents that could result in a long-duration high-temperature fire. Specifically, in response to recommendations by a National Academy of Science committee that studied the transport of radioactive waste, the U.S. Nuclear Regulatory Commission considered transportation operational controls that could be implemented to prevent or mitigate the consequences of a long-duration fire associated with rail shipments.¹² NRC staff requested that the AAR consider revising the AAR Circular on railroad operating practices for transport of hazardous materials, OT-55, to prohibit a train carrying flammable gases or liquids from being in a tunnel at the same time as a train carrying used nuclear fuel. AAR has revised OT-55 to include such a prohibition. NRC staff has concluded that this action to revise the AAR recommended operating practices combined with DOE’s stated policy to use dedicated trains for transporting used nuclear fuel have effectively addressed operational controls that would decrease the probability of rail accidents that could result in long duration fires. DOE should recognize this action on the part of the NRC and AAR in the DSEIS and remove from the list of “reasonably foreseeable” accidents those accidents that consider long-duration high-temperature fires – since the probabilities of this type of accident occurring would now be much lower due to the actions of AAR.

Sections 10.1.2.1.1 and 10.1.2.1.2 on page 10-6 discuss radiation dose to workers loading transportation casks and the public from incident free transportation.

¹⁰ EPRI, Assessment of Accident Risk for Transport of Spent Nuclear Fuel to Yucca Mountain Using RADTRAN 5.5, #1013450, September 2006 (EPRI 2006).

¹¹ U.S. NRC, Memorandum and Order, In the matter of Private Fuel Storage LLC, Docket No. 72-22-ISFSI, CLI-01-22, November 14, 2001.

¹² NRC, 2007a. Reyes, Luis A., Executive Director for Operations, U.S. NRC, to NRC Commissioners, Staff Actions Taken in Response to the National Academy of Sciences’ Study on Transportation of High-Level Waste and Spent Nuclear Fuel in the United States, SECY-07-0095, June 6, 2007

These discussions should acknowledge conservative inputs such as the assumption of the regulatory limit radiation doses at 2 meters from the transportation casks. It should also be acknowledged that actual consequences would be lower than the estimates presented.

- Appendix E2.1.2.2, which describes DOE's approach to addressing the seismic hazard for the repository makes the following statement: "The Department intends to demonstrate seismic margins for the major structures against earthquake ground motions that are *considerably* larger than the design-basis ground motion" (emphasis added). Industry is concerned by the extent to which DOE will apply such "considerable" margin in its repository design, particularly for structures, systems, and components (SSCs) that are part of the repositories pre-closure operations. Through the TAD specification we have learned that DOE intends to require that aging over-packs be designed to not tip over even in the event of an earthquake so severe (3g) that it goes well beyond any known precedent. Through our interactions with NRC regarding Interim Staff Guidance (HLWRS-ISG-1) we have also learned that NRC expects DOE to apply, and DOE has agreed, a novel and untried methodology in the seismic evaluation of repository SSCs. We are very concerned, as expressed in our comments on the draft of HLWRS-ISG-1¹³ that application of this methodology could lead to excessive margin and result in substantial and counterproductive over-design of repository SSCs. We caution DOE that significant over-design could complicate the construction of the repository in ways (such as the increasing the need for materials such as concrete and concomitant increases in labor needs) that would actually increase impacts on the environment as well as to the workers who would be constructing the over-designed SSCs.
- As one example of such over-design, we note that DOE has increased the TAD Alloy 22 wall thickness from 20 to 25 mm, which represents a significant increase in material costs and fabrication requirements. The technical basis for this change is not clear from the SEIS. We are concerned that this increase may be the result of overly conservative seismic assumptions and analyses. If so, this is another example of the costs of over design due to overly conservative performance assessments by DOE.
- Appendix F, Section 2.2, page F-8. DOE points out that the particular sampling "position" for net infiltration is "completely correlated across all four climate states" it uses during its 10,000-year analyses. Indeed, they are correct that this "ensures that the full effects of the infiltration uncertainty are not dampened out of the TSPA-SEIS model performance results." While there may be some correlation across the climate states, the climate/net infiltration models are uncertain enough that "perfect" correlation is unlikely. Thus, DOE's conservative approach of perfect correlation probably increases the dose estimates for at least the first 10,000 years.
- Appendix F, page F-15. DOE should provide the area of the corrosion breaches (patches) considered for the assessment.
- Appendix F, page F-15. Page F-15 bottom: DOE conservatively assumes that a waste package with an "early failure" due to manufacturing defects results "in complete failure". It is much more likely that the manufacturing defect will be

¹³ Letter, Steven P. Kraft to Mahendra Shah, *Nuclear Energy Institute Comments on Division of High-level Waste Repository Safety (HLWRS) - Draft Interim Staff Guidance (ISG)-01, Review Methodology for Seismically Initiated Event Sequences*, 71 *Federal Register* 29369, May 22, 2006, letter dated July 6, 2006

quite small such that the "failed" waste package will provide very significant protection from radionuclide release. Thus, it is likely that DOE's 10,000-year dose estimates are quite conservative due to this assumption. The actual peak dose rate for the nominal scenario would be much, much smaller.

Appendix F, Section F.2.11.1, pages F-24 and 25. The magnitude of the seismic ground motion DOE assumes can occur, i.e., 4 m/s, is a significant overestimate. In its 2006 report on seismic activity, EPRI projects that a more reasonable upper estimate for peak ground velocity (PGV) is 2 m/s.¹⁴ The effect of DOE's PGV overestimate seems to be very significant. For the seismic scenarios, DOE notes that the dominant failure mechanism for the Alloy 22 outer shell of the waste packages is due to stress corrosion cracking (SCC). DOE notes that SCC is primarily caused by waste package damage during seismic events. If DOE had used a more reasonable upper bound on PGV, the amount of waste package failure due to SCC would likely be dramatically lowered. Since peak dose is strongly correlated with the rate and amount of waste package failure, it is very likely that DOE's large PGV assumption results in an overestimate of peak dose, perhaps significantly so.

- Appendix F, Section F.4, page F-32. In Figure F-3, it is unclear what causes the jumps in the projected dose curves. It is likely that DOE has assumed some event, probably a seismic event¹⁵, occurs at exactly the same time in every realization. Given the uncertainty in when seismic events will occur in the future, this assumption seems inappropriate for the probabilistic approach required in Part 63. It seems inconsistent that while DOE corrected the mistake of assuming climate change occurred at exactly the same time for each realization in the FEIS, DOE would make this same type of error for seismic events.

[v.

The sabotage analysis in the Draft Supplemental Environmental Impact Statement is extremely conservative and highly speculative

Used fuel transportation and storage containers are extremely robust and highly resistant to sabotage. The same defense-in depth design philosophy that protects these systems against severe accidents, drops, puncture, fires and submersion in water also makes them highly resistant to terrorist attack. Additionally, NRC regulations¹⁶ require that a strict security plan be in place for all shipments which will carefully track and monitor the shipments as well as establish specific procedures to protect against sabotage and theft.

Industry believes that DOE has not taken these security precautions properly into account and, as a result, the DSEIS significantly overestimates both the likelihood and potential consequences of a sabotage event. The extreme over-conservatism in the Department's approach diminishes the value of this DSEIS as a public communication tool, as it potentially could raise concerns that are not justified. Several examples of this problem, as well as recommendations for better communicating the context of the scenarios evaluated, are provided below.

¹⁴ *Effects of Multiple Seismic Events and Rockfall on Long-Term Performance of the Yucca Mountain Repository*. EPRI, Palo Alto, CA: 2006. 1013444.

¹⁵ On page F-46, DOE notes that for the 10,000-year time period TSPA calculations, seismic events are assumed to occur at exactly the same time for each realization. While DOE does not specifically state the same assumption was made for the 1,000,000-year time period TSPA calculations, the results in Figure F-3 seem consistent with such a conservative assumption.

¹⁶ 10 CFR Part 71.5, 10 CFR 73.37, and 49 CFR Part 172: Subpart I

Section 2.3.2, page 2-58, discusses severe accident and sabotage scenarios and the resulting estimated consequences. Based on the information in the document Appendices and references, the analysis includes very conservative input assumptions regarding response to the sabotage or accident events. This should be noted in the text along with analytical results of more reasonable scenarios. For instance, estimates assuming evacuation within a few hours one half mile from the severe event would be more reasonable and should be included as a point of reference. Bounding analysis is useful to DOE impact analysts, but, absent qualification, it tends to misinform the public.

Section 2.3.3, page 2-70, states in the last bullet of the section, "For both scenarios, the risks in relation to sabotage and diversion of fissionable materials at the commercial and DOE sites would be much greater than they would be if the materials were in a deep geologic repository." This statement is misleading in that it suggests that materials at existing sites are vulnerable and the associated risk of sabotage and diversion is high. The risk of sabotage and diversion is low at existing sites; however, permanent disposal in a deep geologic repository clearly offers benefits in terms of costs and sustainability for long-term secure disposition of used nuclear fuel.

- Section 4.1.8.4, pages 4-74 and 75 (and Appendix E, Section E.7), reasonably describes why a successful sabotage attempt on a repository is unlikely. It then goes on to present the results of an assumed successful sabotage event that could never happen. The details of the analysis described in Appendix E, Section E.7 assume a "perfect storm" of events including a successful aircraft attack into a specific building, a worst case resulting fire, 100% of the maximum inventory in the building affected by the attack, and the waste form being turned into a powdered oxide form and dispersed. An assumption of no evacuation for 24 hours is a little more reasonable than the 30 days assumed for accidents, but is still much longer than would actually be the case after a successful aircraft attack on repository facilities. To present only the results of a very conservative analysis in effect provides misinformation to the public in the vicinity of the repository. The results of a more likely scenario should be presented along side the very conservative analytical results.
- Section 6.1.11, page 6-7, recognizes that previous estimates of sabotage consequences in the FEIS could be overstated by a factor of 2.5 to 12. DOE is commended for recognizing its overestimates and providing more realistic assessments. The concept of more reasonable assessments should be applied throughout the SEIS. However, the assessment of transportation sabotage risk in the DSEIS is overly conservative. Table 6-8, Section 6.3.4 (page 6-23) provides an estimate of the impacts of sabotage events involving truck or rail casks that utilizes updated release fractions to calculate radiological risk. The sabotage risk assessment utilizes the same conservative assumption used in the assessment of accident risk discussed above. While the updated release fractions do reduce conservatism in the FEIS analysis, the release fractions do not take into account the additional barrier that a TAD canister would add in a sabotage scenario. In addition, while the SEIS assumes that a PWR TAD package would hold 21 assemblies, DOE chose to estimate the consequences of a rail sabotage event based on the radionuclide inventory in 26 PWR assemblies, "which overestimated consequences by about 24 percent in comparison to the inventory in 21 pressurized-water reactor used nuclear fuel assemblies." (Section G.9, page G-49).

As a core legal matter, NEI notes that evaluating the environmental impacts of potential terrorist attacks against nuclear facilities and activities not only severely distorts the National Environmental Policy Act (NEPA), it is not a general legal requirement. U.S. Supreme Court decisions in *Metropolitan Edison Co. v. People Against Nuclear Energy*, 460 U.S. 766 (1983), and *Department of Transportation v. Public Citizen*, 541 U.S. 752 (2004), make clear that NEPA should not be construed to force agencies to consider environmental impacts for which they cannot reasonably be held responsible. In *Metropolitan Edison*, the Court held that NEPA did not require the Nuclear Regulatory Commission (NRC) to consider the "severe psychological distress" that local residents might suffer if a nuclear plant resumed operation, even though relicensing the plant would be a "but-for" cause of any such distress. *Metropolitan Edison*, 460 U.S. at 774. The Court explained that "[t]ime and resources are simply too limited" for Congress to have intended to extend NEPA to cover every conceivable impact of any agency's decision. *Id.* at 776. Instead, the Court recognized that NEPA's underlying policies and Congress's intent limit the Act's scope in a manner similar to "the familiar doctrine of proximate cause from tort law." *Id.* at 774. Applying that limitation, the Court found the causal relationship between the federal action at issue, an ensuing change in the physical environment, and the feared distress of residents "too attenuated" to make the NRC potentially "responsible for [the feared] effect" in a way that required NEPA analysis. *Id.* at n.7. The residents' claim "lengthen[ed] the causal chain beyond the reach of NEPA." *Id.* at 775.

In *Public Citizen*, the Court again recognized common sense limitations on the scope of NEPA. The President had made clear that he would lift a ban on cross-border operations by Mexican motor carriers, subject to the promulgation of safety regulations by the Federal Motor Carrier Safety Administration (FMCSA). The FMCSA's NEPA assessment considered the increased emissions and noise that would result directly from the inspection regime to be established by the regulations, but not the environmental consequences that might be caused by the increased cross-border traffic itself. The agency reasoned that those consequences resulted from the President's decision to permit the traffic, not from the agency's safety regulations. *Public Citizen*, 541 U.S. at 760-61.

The Supreme Court agreed. Although the regulations were a condition precedent to the cross-border traffic, and would inevitably trigger the environmental effects, that was "insufficient to make [the FMCSA] responsible for [those] effect[s] under NEPA." *Id.* at 767. Moreover, while NEPA aims to ensure that agencies consider information about potential environmental effects before deciding whether and how to take a particular action, and to facilitate public participation in that consideration, those purposes also limit the statute's reach:

[I]nherent in NEPA and its implementing regulations is a "rule of reason," which ensures that agencies determine whether and to what extent to prepare an [Environmental Impact Statement (EIS)]. . . based on the usefulness of any new potential information to the decision making process. Where the preparation of an EIS would serve "no purpose" in light of NEPA's regulatory scheme as a whole, no rule of reason worthy of that title would require an agency to prepare an EIS. *Id.* at 767 (citations omitted).

The foregoing notwithstanding, NEI recognizes that the controlling law in the Ninth Circuit is to the contrary. See *San Luis Obispo Mothers for Peace v. NRC*, 449 F.3d 1016 (2006), *cert. denied*, — U.S.—, 127 S. Ct 1124 (2007). Accordingly, since

Yucca Mountain is within the geographic boundaries of the Ninth Circuit's jurisdiction, DOE's analyses are compelled under the circumstances. Nevertheless, in conducting such analysis DOE should either take care to avoid excessive speculation and conservatism or, at least, explain the speculative and conservative nature of its analysis.

VI.

Transportation, Aging, and Disposal (TAD) canisters are a valuable means of simplifying repository operations. However, it is also important that DOE has recognized that as much as 25% of commercial used nuclear fuel will be shipped to the repository in conveyances other than TADs to avoid the cost and radiation exposure associated with reloading DPCs.

Shipping as much of the inventory of commercial used nuclear fuel in TAD canisters as possible will maximize the benefits of the operational simplification accrued from this concept. However, given the reality that a significant amount of commercial used fuel is and will continue to be placed in non-TAD systems prior to TADs becoming available, we find DOE's decision to consider, in this SEIS, the possibility that it might, in reality, receive up to 25% of the commercial inventory in non-TAD canisters (DSEIS Section 2.1.1) to be both reasonable and prudent. If DOE did not provide for the receipt of a significant amount of used fuel in non-TAD canisters, significant unnecessary costs and radiation exposure would have to be incurred to unload existing dual purpose storage and transportation systems. Furthermore, several decommissioned sites have already removed their used fuel pools and would be incapable of unloading already loaded systems even if such costs and exposures could somehow be justified.

There are currently 9,600 metric tons of used nuclear fuel in dry storage, in non-TAD storage and dual purpose storage and transportation systems, and industry estimates that by 2012, the date at which DOE has indicated that it expects TAD canisters to be available, there will be approximately 13,600 metric tons of used nuclear fuel in dry storage. The current dry storage inventory represents 15% of the 63,000 metric tons of commercial used nuclear fuel that DOE has allotted as part of the 70,000 metric ton limit placed on it by the NWPA but only 7% of the 130,000 metric tons of commercial used fuel disposal capability DOE has provided for in the SEIS Inventory Modules I and II. By 2012, the earliest date upon which DOE anticipates that TADs will be deployed in the commercial dry storage marketplace, the non-TAD storage percentages will rise to 21.5% of the NWPA allotment and 10% of the DSEIS evaluated capacity.

The numbers above indicate that DOE's objective of receiving no less than 75%, and perhaps up to 90%, of commercial used nuclear fuel in TADs, is achievable. For this to be accomplished, DOE must work diligently to assure that the TAD development process can proceed as expeditiously as possible. Industry is interested in continuing to work with the Department on TAD development.

VII.

DOE should proceed with the infrastructure improvements described in the Draft Supplemental Environmental Impact Statement at the earliest possible date to facilitate timely repository construction once authorization is received from NRC.

In the DSEIS, DOE has evaluated the environmental impacts of several infrastructure activities that could be pursued in advance of the repository construction authorization. Pursuing these activities in advance would be highly beneficial in preparing DOE to begin repository construction, should construction authorization be received

from NRC. Notable examples of such opportunities, which we recommend DOE pursue as soon as funding can be made available, are described as follows:

- Section 2.1.4.2, page 2-37, discusses the Engineering and Safety Demonstration Facility. DOE is commended for including such a facility and particularly for including public outreach as part of its mission.

Section 4, page 4-2 and Section 4.3, pages 4-111 and 112 discuss actions, such as road and utility upgrades, outside the Geologic Repository Operations Area (GROA) that DOE plans to implement prior to receiving construction authorization from NRC. DOE's efforts to make its current activities as safe and efficient as possible, while at the same time being ready to begin repository construction upon authorization by NRC is commended.

- Section 4.3, page 4-111 to 4-127, discusses several infrastructure improvements that DOE may implement prior to receiving authorization to construct the Geologic Repository Operations Area (GROA) from the NRC. These non-GROA improvements would enhance worker safety and operations efficiency of ongoing activities. DOE is applauded for taking action to make its activities as safe and efficient as possible while at the same time being as ready to begin repository construction upon authorization by NRC.

VIII. Additional information on industry capabilities that DOE should consider regarding expectations for the relative number of truck vs. rail shipments.

In evaluating transportation impacts, DOE appears to have overestimated the number of used fuel shipments that will travel to Yucca Mountain by truck and underestimated the number of rail shipments. A partial review of industry infrastructure indicates that there are at least a half dozen plants that are shown in Table G-10 as requiring truck shipments that either have made, or are planning to make facility upgrades that will provide capability to ship by rail. Many of these sites are planning to load dual purpose canisters that must be shipped by rail. DOE should not presume that truck shipments will be coming from sites that have already committed to loading rail casks. The operators of these sites have no intention to reload used fuel and, after the plants are shut down, will have no capability to do so. Industry would be happy to provide this information to DOE and is interested in working with DOE to assure that the most up to date information on likely shipment modes is considered in finalizing this DSEIS.

IX. Specific detailed technical comments

In addition to the overall recommendations made above, we offer the following specific comments for DOE's consideration.

Relative distribution of vertical and horizontal storage over-packs on the Yucca Mountain aging pads (Section 2.1.2.1.3)

Section 2.1.2.1 of the DSEIS describes the waste handling facilities and operations to be performed at the GROA. Canistered commercial used nuclear fuel is expected to be received in either TADs or dual-purpose canisters. Commercial used fuel in dual-purpose canisters (horizontal or vertical) would be either transferred to the Wet Handling Facility to be offloaded and repackaged into TADs or transferred to the aging facility to be placed in aging overpacks (either horizontal or vertical). While DOE is to be commended for providing a balanced consideration of both vertical and horizontal storage systems, there is one statement in this section that requires clarification.

tion given that DOE postulates receiving approximately 75 to 90% of the commercial used nuclear fuel in TAD canisters for which DOE has, at present, only specified a vertical aging overpack design.

On page 2-18 a discussion is provided that "Transportation casks that contained horizontal dual-purpose canisters would be moved to a transfer trailer and from there to the aging pad where the horizontal dual-purpose canisters would be pushed into the aging overpack". If DOE intends to provide for horizontal aging at the aging facility, this should be explained. Otherwise, those transportation casks that contain horizontal dual-purpose canisters would more effectively be directed to the wet handling facility to be unloaded immediately and repackaged into TAD canisters that would then be aged vertically.

In describing any plans for both vertical and horizontal aging DOE should address the additional operational complexities that would result from using two distinctly different aging systems because of different methods of handling (hydraulic ram, horizontal transfer vehicle, etc.). The environmental impacts of a dual system would need to be compared to those that would result from the pre-aging transfer of the commercial used fuel from horizontally-based canister systems into TAD canisters to provide for aging of the used fuel in the vertical configuration, like the rest of the used fuel. In doing this, DOE should continue to seek a fair balance between the need to simplify operations at the repository sites and the need to accommodate a diverse range of disposal customers using both vertical and horizontal systems at reactor sites.

Purpose of underground panel access

Section 2.1.2.2.1, pages 2-25 through 2-27, discusses access to the underground panels. It is not clear whether the access discussed is for construction, emplacement, or both. This should be clarified.

Thermally accelerated drifts

Section 2.1.5, page 2-41, discusses obtaining data "... during the preclosure period using thermally accelerated drifts." The concept of thermally accelerated drifts should be explained. }

Description of Ruby Valley Treaty lands

13 Section 3.1.1.3, page 3-8, discusses 97,000 square kilometers of land that is the subject of the Ruby Valley Treaty of 1863. The first paragraph says it's all in Nevada and the second paragraph says it's in Nevada, Utah, California, and Idaho. The discussion needs to be correct and consistent. }

- 14 [Restricted area locations
Section 3.1.1.4, page 3-9, describes restricted area R-4808 as being part of the Nevada Test Site. Figure 3-2 shows area R-4808 extending beyond the test site boundary on the west. Either the text or the figure should be corrected.]
- 15 [Commercial Used Nuclear Fuel Oxidation (Section 4.1.8.1.4 and Appendix E 3.3.1)
Section 4.1.8.1.4 and Appendix E.3.3.1: Oxidation rates are strongly dependent on temperature, among other factors; accordingly the SEIS should indicate the elevated temperature considered in the development of the 30-day release period.]
- 16 [Radiation exposure value corrections
Table 4-25, page 4-71, states the maximally exposed offsite individual would receive 23 rem under 95th percentile meteorological conditions. The corresponding table in Appendix F also has this value. This value is likely much lower and a misprint in both tables based on the corresponding latent cancer fatality probability. Summary section, S.3.1.8.1 says the value is 23 millirem. The value should be corrected.]
- 17 [Editorial Comment
Page 5-16: In the box item, DOE makes reference to a Section 5.2.4.2.3. This section does not exist.]
- 18 [Presentation of long-term performance assessment results
Section 5.5, all. DOE should present the 10,000 year and 1 million year radiological performance results in tabular form showing how much each analytical scenario contributes to the total system performance results. This is particularly necessary since the graphs shown in black and white in this section are unclear.]